FARMERS' BULLETIN NO. 2153

feeding DAIRY CATTLE

UNITED STATES DEPARTMENT OF AGRICULTURE

Feeding dairy cattle involves more than providing them with good feed needed to produce milk; feeding must be done at a profit.

When you plan feed crops for cattle, think in terms of pounds of milk per acre, not bushels or tons of feed. Through increased milk output, one feed may bring you more profit than another feed.

Because yearly differences in soil and weather can change the yield and quality of the feed you raise, your feeding plan should be flexible. You must effectively use the feed supply available each year.

Your feeding program should be simple and workable. It should meet the needs of all the animals in your herd and use the least number of different feed mixtures.

Plan your feeding program to take advantage of—

- **Good pastures.**
- **Good homegrown forages and concentrates.**
- **Wisely purchased concentrates and supplements when needed to provide a balanced ration.**

CONTENTS

feeding DAIRY CATTLE

You can increase the milk production of your dairy herd through better feeding.

Much of the increase can come by using improved practices in pastures, in harvesting, and in preserving forage, and by providing adequate forage rations throughout the year.

The cheapest source of nutrients for dairy cows is home-produced forage crops. Of the forage crops, pasture is the cheapest to produce; next in order are preserved forages and grains. On most farms, 75 to 80 percent of the nutrients required by dairy cattle can come from forage.

FEEDING NEEDS

A ration for dairy cattle should supply protein, energy, water, minerals, and vitamins.

Protein

Protein must be present in dairy rations for growth, maintenance of body tissues, and milk production.

An insufficient amount of protein in the ration slows growth and milk production because the animal takes care of its body maintenance requirements first.

Producing cattle require about 0.6 of a pound of digestible protein to maintain each 1,000 pounds of body weight. In addition, they need as digestible protein in the ration about 1.25 times the protein in the milk produced. Milk contains about 3.5 percent of protein.

Cattle, unlike swine or poultry, do not need both plant and animal protein in their diet for proper nutrition.

Plant sources of protein seem to be as useful to cows as animal protein; bacteria in the paunch are able to form most of the essential amino acids required by cows.

If an excess of protein is fed, it is used as a source of energy. Where protein concentrates are more expensive than carbohydrate concentrates, it is more economical to feed only the amount of protein needed to meet requirements.

Energy

If they are to grow and produce milk, cows must have a supply of energy above that required for body maintenance.

The usual sources of energy are carbohydrates and fats. If the dairy ration does not contain enough energy, protein that might otherwise be used for maintenance, growth, or milk production is used for energy. For this reason there should be a balance between protein and energy sources in the diet.

Water

Water is important for the health and nutrition of all animals. Because milk is about 87-percent water, a cow producing 50 pounds of milk per day needs about 44 pounds (pints) of water simply to replace that excreted in the milk.

Cows may drink 3 to 4 pounds of water for each pound of milk produced, or 3 to 4 pounds of water for each pound of dry matter consumed.

If drinking cups are not available, cows should be permitted to drink at least twice each day. Lack of good clean water will cause a decrease in milk production.

Minerals

Cattle need minerals for skeletal growth, milk production, and to support metabolism. Important minerals for a dairy ration are calcium, phosphorus, magnesium, sodium, chlorine, iodine, copper, iron, cobalt, and manganese.

Most of the calcium and phosphorus is in the skeleton. A deficiency of one or both of these elements will cause rickets, osteoporosis, and erosion of the cartilage in the joints. Joint stiffness is one of the symptoms of these conditions. Poor appetite may be caused by a phosphorus deficiency.

Calcium deficiency rarely occurs in dairy cattle when sufficient forage is consumed. Forages are high in calcium content and concentrates are low. If hay consumption is as low as 5 or 6 pounds per day and the rest of the ration is made up of concentrates, calcium deficiency may occur. When it is necessary to feed a large proportion of concentrates, a calcium supplement, such as ground limestone, may be added.

Phosphorus deficiency may occur in areas where forages and home-grown grains are low in phosphorus and where no protein concentrates are fed. High-protein feeds such as bran, soybean meal, linseed meal, or cottonseed meal, contain phosphorus.

Generally, phosphorus is added to the concentrate mixture in amounts of 1 percent of bonemeal, dicalcium phosphate, or defluorinated phosphate. When the grain ration contains 15 to 20 percent of protein, it is not necessary to add a phosphorus supplement.

Salt (NaCl) is needed by animals for body processes. A salt deficiency is indicated by rough coat, lack of appetite, and strong craving for salt. Rapid loss of weight and a decline in milk production are other signs of salt deficiency.

Some salt should be fed because the ordinary ration does not contain enough. The daily requirements for salt are about 0.75 ounce for body

use and about 0.3 ounce for each 10 pounds of milk produced.

Mix 1 percent of salt in the grain mixture and allow your cattle free access to a salt box located in the exercise lot. A common practice is to mix 2 parts bonemeal and 1 part salt for a mineral box in the exercise lot, although some farmers place the two minerals in separate boxes.

Iodine deficiency frequently occurs in areas around the Great Lakes and, more recently, in several other areas of the country. It is indicated by "big neck" in calves at birth.

Salt containing 0.015 to 0.0076 percent of iodine should be used in deficient areas. One ounce of potassium iodide mixed with 300 pounds of salt will furnish the necessary iodine. Most salt sold for animal feeding contains added iodine.

Cobalt deficiency also occurs more frequently in certain areas of the country—particularly in the Northeast, the Great Lakes, and Florida.

The symptoms of cobalt deficiency are loss of appetite and emaciation. Even when they have plenty of feed, animals with cobalt deficiency die of starvation.

The most satisfactory method of administering cobalt to cattle is to feed a mixture of ½ to 1 ounce of either cobalt chloride or cobalt sulfate in 100 pounds of salt.

Copper and iron deficiencies have been recognized in Florida.

Many commercially mixed concentrates contain added quantities of salt, calcium phosphorus, iodine, and cobalt. Some may also contain added copper, iron, and manganese. Salt containing added iodine, cobalt, copper, and iron is available.

Vitamins

Producing cattle need vitamins A, D, and E in their feed. They probably have requirements for other vitamins, but these are produced in the paunch.

A deficiency of vitamin A causes blindness in growing animals and poor reproduction in mature animals. Poor reproduction is indicated by weakness and poor survival of calves at birth.

The principal source of vitamin A in cattle rations is the yellow pigment, carotene. This is found in carrots, good-quality green hays, pasture, and silage. Hays that have weathered or carried over from one year to the next are low in carotene.

Vitamin A deficiency rarely occurs, although it has been observed. It may occur where low-quality hay, straw, or fodder corn are fed or during drought periods on the range. Or, this deficiency may occur where cattle subsist largely on concentrates with small amounts of hay.

If your cows receive as much as 10 pounds of good hay daily, vitamin A deficiency is not likely to occur.

The amount of carotene a cow receives affects the amount of vitamin A in the milk. Cows on pasture or fed grass silage produce milk, high in vitamin A and carotene.

Vitamin D is essential for maintenance, reproduction, and lactation in mature dairy cattle.

Under usual farm conditions, adequate amounts of vitamins D and E are supplied by the action of sunlight on the animal's skin and by the forages consumed.

CLASSES OF FEEDS

Dairy cattle feeds can be divided into forages and concentrates.

Forages

Forages are hays, silages, pasturage, and soilage.

Hays

Hays are made from grasses, legumes, or cereal crops.

Few hays consist of only one type of plant. Usually, hay is a mixture of legumes and grasses.

Hay is one of the cheaper sources of nutrients for dairy cattle; it is one of the most important feeds.

Hay differs more in feeding value than any other feed because of the differences in the crop, stage of cutting, handling, and possible weathering during curing.

During the curing process, quality and feeding value of hay is decreased rapidly by rain, sun bleaching, raking, handling when too dry, and storing with too much moisture. Barn drying can overcome some of these difficulties.

Legume hays are higher in protein, calcium, and carotene than grass hays. They usually are more palatable and higher in feeding value.

Of course, poor-quality legume hays—those cut at a late stage of maturity and exposed to weathering—are not as good as high-quality grass hays.

Alfalfa is the most common legume hay. It yields a higher tonnage of hay per acre than other hays and has highest protein content.

The leaves of good-quality alfalfa make up about 50 percent of the weight of the plant and contain 75 percent of the protein. If the hay has lost most of its leaves, it has lost the advantage of legume hay.

Where good-quality alfalfa hay is available in adequate amounts, you need not buy protein concentrate. Cows will consume 2 to 3 pounds of good alfalfa per 100 pounds of body weight.

Clover usually is grown mixed with timothy and is lower in protein than alfalfa. Clover-timothy mixed hays are not as good in quality because the clover is cut at a too-mature stage—when the timothy is ready. Earlier cutting would make a better quality hay, but would increase the difficulties of curing.

Lespedeza hay has become a fairly common crop in some areas. Usually, this hay contains foreign materials, such as straw and weeds, that decrease its feeding value.

Lespedeza, if it is fine stemmed and free of foreign material, is an excellent hay when cured without weather damage.

Other legume crops—soybeans, cowpeas, and vetch—are often made into hays but are not as valuable as alfalfa. They are difficult to cure and are generally more stemmy.

If they are cut at the proper stage and cured without loss of leaves, they make good feeding hays.

Grass hays include prairie grass, redtop, Johnsongrass, orchardgrass, and timothy. When cut at the usual stage of maturity, grass hays are less palatable than legume hays and are

M-3495

Good pasture is the most economical feed for dairy cows.

lower in protein and minerals. However, early cutting of grass hays from heavily fertilized meadows produces a palatable hay with about as much protein as alfalfa.

Grass hay usually will grow in a wider range of conditions than alfalfa, but yields less dry matter per acre.

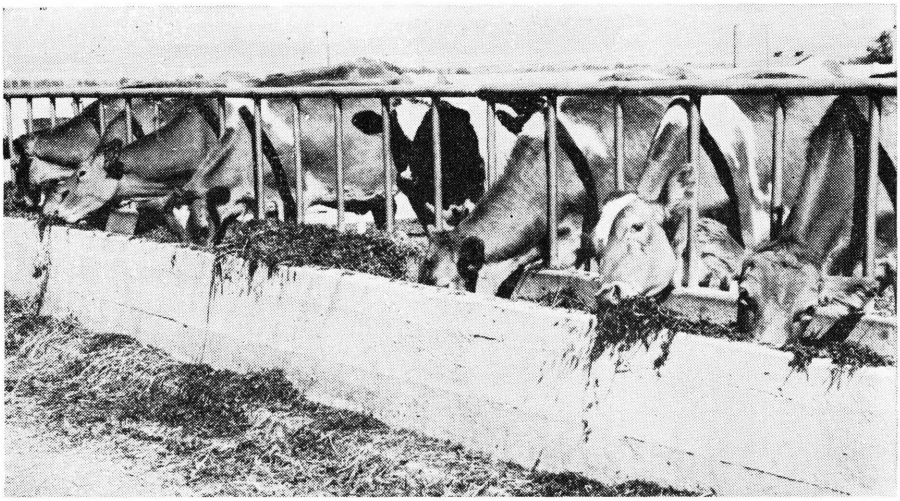
Cereal hays are made from oats, barley, wheat, and rye. These hays, when cut sufficiently early in the flower stage and before the milk stage, retain much of their green color and have fair feeding value.

If cut too early, yield is reduced and, if cut too late, the hay becomes fibrous and low in feeding value. Cereal hays are low in protein and must be fed with a protein supplement, legume hay, grass silage, or corn silage.

Silages

Silages are of two types. One type includes all silages made from hay crops—grass and legume silages. The second type has no general name; examples are corn silage, kafir silage, and sorgo silage.

Grass and legume silages preserve more of the nutrients than if the hay crop was made into field-cured hay. However, a hay crop that will not



79769

Calcium deficiencies rarely occur where cattle eat sufficient forage.

make good hay under good weather conditions will not make good silage.

When you make silage, knowing the quality of your hay crop helps you in assessing feeding value.

The aroma of the silage is sometimes used to judge its quality. A strong butyric acid odor—like rancid butter—is not desirable. This odor usually develops in silage put up when too wet or to which insufficient preservative has been added.

Wilted silage has a lower moisture content and a sweet silage aroma that is desirable.

The moisture content of silage does not always affect quality in grass silage, although it does affect the feeding value per pound.

If a cow is eating 50 pounds of grass silage with 55 percent of moisture, she is getting 22.5 pounds of dry matter.

If the silage contained 70 percent of moisture, which is more common, she would be getting only 15 pounds of dry matter—a difference of almost 70 percent in dry-matter intake.

On a dry-matter basis, grass silage is equal in feeding value to hay. However, if the hay has been weather damaged the silage has a higher feeding value.

In humid areas, it is likely that grass silage will have a higher feeding value than hay made in the same area because of the weather damage.

Many herds have been fed grass silage as the sole forage with good results. However, more total forage will be eaten if some hay is fed with the grass silage. Five to ten pounds of hay per day should be adequate if fed with wilted silage containing 65 to 70 percent of moisture.

If the moisture content of the silage is higher, 75 to 80 percent of moisture, feed 10 to 15 pounds of hay per day. Grass silage can be fed in place of corn silage or in combination with corn silage and a small amount of hay.

Corn silage usually yields more

nutrients per acre than other silage crops. It is one of the most economical and palatable feeds of the harvested forages.

It is lower in protein than grass silage but on a dry basis it is slightly higher in energy. The feeding value of either, of course, depends on moisture content.

Generally, corn silage and grass silage can replace each other on a dry basis. When corn silage is fed, the grain ration should have a higher protein content.

Corn silage is usually fed in amounts of 20 to 60 pounds per cow per day. Forty pounds of corn silage contain 5 to 6 pounds of corn. This accounts for the high energy value of corn silage.

Where the source of hay or other silage is limited, corn silage can be fed as the principal roughage with only 5 to 10 pounds of hay per day.

If no hay is available, the grain ration should be increased because cows will not eat enough corn silage to meet their energy needs.

Other crops related to the sorghums, such as kafirs, feteritas, and sorgos, all make good silages but are not quite as palatable as corn silage.

Pasturage

Pasturage is the plant growth available to animals on the range or in the pasture. It is the most economical feed for the dairy cow because she does her own harvesting. It is usually the cheapest source of nutrients on the farm and can furnish as much as one-third of the nutrients required by the cow for the year. Cows on good pasture need only small amounts of concentrates.

Often, pasture is the most neglected crop on the farm. Through proper management—renovation, rotation grazing, fertilization, and use of legumes—the pasture season can be lengthened. Also, nutrient production can be doubled or even tripled at a reasonable cost.

Irrigation is being used in some areas to improve pasture production. Other improvement methods are strip grazing, or short rotation grazing periods of 1 or 2 days, and soiling.

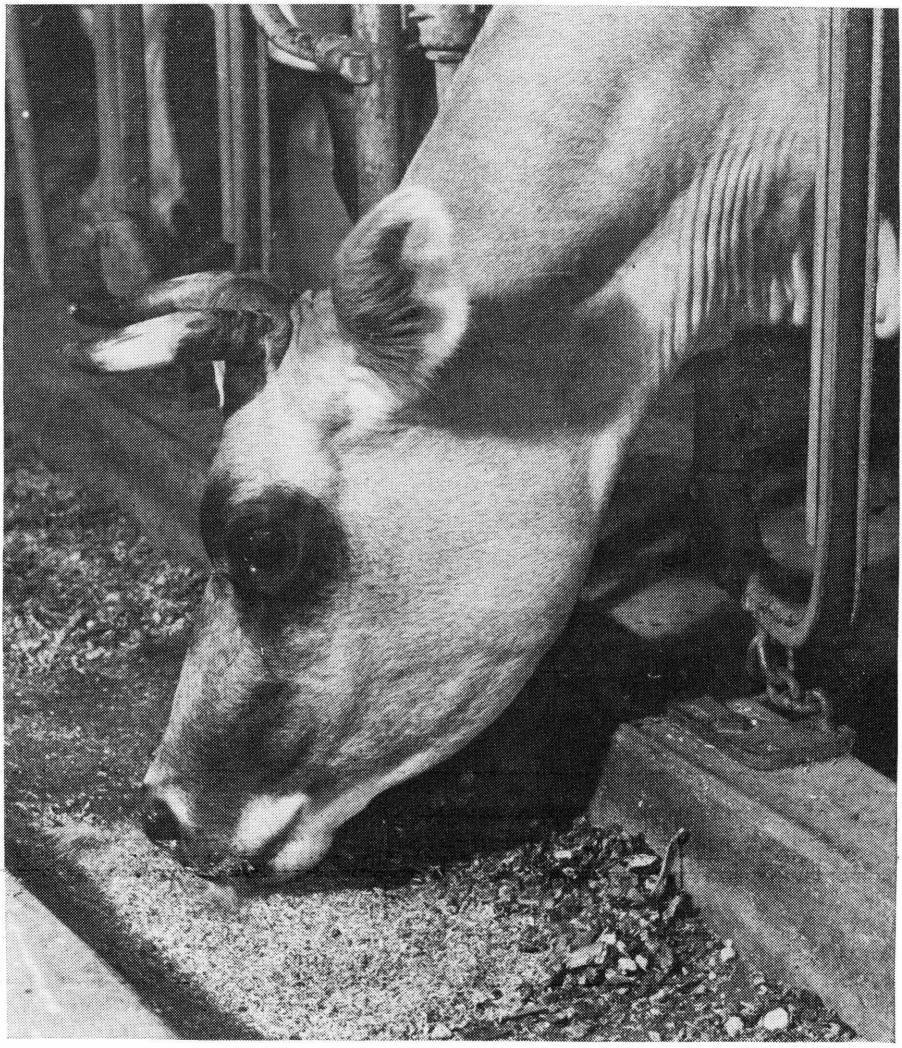
At the beginning of the pasture season—when the pasture is immature—it is high in protein, vitamins, and minerals. Pasture has a higher nutritive value than hay but lower than concentrates.

As plants become more mature, their value decreases. When the feeding value of pasture declines, other feed must be given to keep up energy intake. Without proper management, the pasture may have little value during the middle of the summer.

Soilage

Cutting green growing crops and feeding them directly to the herd is called soiling. The cut crops are called soilage. This method of feeding is also known as green feeding or zero grazing. It is an effective way to supplement poor pasture by using a crop, such as corn, that is not usually grazed.

The development of machinery for handling crops has made soiling more economical than in the past. Soiling has the disadvantage that a crop may not always be available at the proper stage for feeding. Proper crop plan-



AAA-11085-W

Concentrates are necessary for additional milk production.

ning can overcome some of this disadvantage.

Hay crops can be used for soiling instead of grazing. For soiling to be economical, a herd of 30 or more cows is required. Soiling does not increase carrying capacity above that of a correctly managed rotation system of grazing.

Other Forages

Corn fodder, including the ears and stalks, is sometimes fed to dairy cattle. It is not as high in feeding value as corn silage and there is wastage from the coarse stalks. Too, some of the kernels pass through the cow without being digested.

It is better to shred the fodder and remove and grind the ears. Cattle eat more of the shredded stalk.

The crop should remain in the shock for at least 2 months before shredding. This will allow the stalk to dry properly. Undried, shredded fodder will mold and heat. Molasses can be added to increase palatability.

When some farmers fill their silos with dry corn fodder, they add water. This makes a fair feed, but it is not as good as corn silage put up at the correct stage of maturity.

Concentrates

Concentrates have high energy value and contain little crude fiber. They may contain large amounts of protein or carbohydrates.

Protein concentrates—those containing large amounts of protein—have high energy value. Cottonseed meal, linseed meal, and soybean meal are protein concentrates.

Carbohydrate concentrates also are high in energy but have less protein. Corn, wheat, barley, and oats are in this class.

Although concentrates may have about the same dry-matter content as hay, concentrates are much higher in productive energy.

Concentrates have little crude fiber but they contain large amounts of starches that are more digestible than crude fiber.

However, some feeds—dried beet and citrus pulp, for example—come in between concentrates and forages. They would ordinarily be classed as forages because they contain large amounts of crude fiber. This crude fiber is highly digestible and has a higher energy value than most crude fibers. Therefore, these feeds should be classed as concentrates.

Concentrates may contain up to twice as much productive energy per pound as forages. Some concentrates contain large amounts of fat and can provide an even higher proportion of energy.

The protein content of concentrates can differ greatly. Homegrown grains—corn, oats, wheat, barley, kafir, and rye—contain 7 to 10 percent of total protein, or 4 to 7 percent of digestible protein.

Some of the mill feeds contain an intermediate amount, about 15 percent, of protein. These include wheat bran and wheat middlings. Other feeds in this group that are slightly higher in protein are corn-gluten feed, dried brewers' grains, and dried distillers' grains.

Soybean meal furnishes more than 50 percent of all the protein concentrates used in the feed industry. Other high-protein concentrates are linseed meal, cottonseed meal, and peanut meal.

Digestible protein content of some concentrates:

5 to 10 percent
- Beet pulp (dry)
- Corn-and-cob meal
- Cornmeal
- Hominy feed

10 to 15 percent
- Barley
- Feterita grain
- Milo grain
- Oats
- Rye
- Sorghums, ground

10 to 15 percent (cont.)
- Wheat

15 to 20 percent
- Oatmeal
- Red dog flour
- Sunflower seed (with hulls)
- Velvetbean meal (pods included)
- Wheat bran
- Wheat middlings

20 to 25 percent
- Brewers' grain (dry)
- Cowpeas
- Distillers' grains (dried)
- Gluten feed
- Distillers' solubles (dried)
- Peanut meal (with hulls)

25 to 30 percent
- Buckwheat middlings
- Gluten meal (low grade)

30 to 35 percent
- Linseed meal
- Soybeans

35 to 40 percent
- Gluten meal (high grade)
- Cottonseed meal

40 to 45 percent
- Peanut meal (without hulls)
- Soybean meal (solvent extracted)

45 to 50 percent
- Peanut cake (from hulled nuts)
- Soybean meal (dehulled-solvent extracted)

Commercial Mixed Feeds

About 30 percent of all concentrates fed to dairy cattle in the United States are commercially mixed. These feeds must comply with laws requiring a statement of minimum and maximum chemical composition and a list of ingredients on the feed tag.

The best-quality mixtures are generally low in fiber. A high-fiber feed contains some low-energy feeds such as oat hulls, corn cobs, cottonseed hulls, or ground hay.

Fiber percentage should not exceed 9 to 10 percent in a high-quality mixture. Fat content should not be less than 2.5 to 4 percent. Productive energy value should be between 70 and 75 therms or pounds of TDN per 100 pounds of feed.

When you purchase feeds, examine the tags and consider the reliability of the manufacturer. The proportions and ingredients in commercially mixed feeds change because of differences in availability and price.

In any season, one ingredient may become cheaper than another ingredient of comparable feeding value. Shifts of ingredients by the mixer are justifiable as long as palatability and quality are maintained.

Many feed manufacturers mix high-protein supplements containing 24, 32, or 36 percent of protein. These supplements may be mixed with homegrown grains. However, you should determine whether protein from these mixes is more expensive than protein from a regular protein concentrate. Some supplements have salt and minerals already added for mixing with homegrown grains.

USING FEEDS

Feeding Forage

Cows eat large quantities of forage when it is of good quality. If you produce good-quality forage on your farm, it will not be necessary to feed a large amount of grain for most economical milk production.

The amount of forage a cow eats depends on quality and kind of forage, size of the cow, and amount of milk she is producing. Cows on good-quality alfalfa that are producing a reasonable quantity of milk consume up to 3 pounds of hay per 100 pounds of body weight.

If grain is fed in moderate amounts, the quantity of hay or hay equivalent consumed will be reduced to about 2 pounds per 100 pounds of body weight. Each pound of grain fed reduces hay consumption by 0.7 pound. Usually, 3 pounds of corn or grass silage is equivalent to 1 pound of hay.

Poor-Quality Forage

A good-producing dairy cow requires a large energy intake. If you feed a cow poor-quality forage with low-energy content, more energy must come from expensive concentrates. However, poor-quality forage can be used in an emergency, for maintaining dry cows or dairy heifers.

Hays

Quality in hays can be measured by grades set up by the U.S. Department of Agriculture. These grades for hay indicate amount of leaf, color, and amount of foreign material.

Under average farm conditions very little (about 10 percent) No. 1 hay is produced. The greater amounts fall in No. 2, No. 3, and Sample grades of hay. Much of this hay could have graded higher with proper finishing.

A farmer must be able to estimate the nutritive value of the hay he is feeding. For instance, if alfalfa is cut at the mature-seed stage, it is lower in feeding value than when cut earlier in the bloom stage.

If the hay is weathered and there has been a large leaf loss, feeding value may be greatly lowered. Usually poor-quality hays are high in crude fiber and low in protein and productive energy.

Higher grades of hay have a higher leaf, protein, and carotene content and a lower fiber content. Animals fed higher grades of hay consume larger quantities and, therefore, make larger body-weight gains and are more efficient.

The protein content of hays is important because it determines the amount of protein the grain mixture fed should contain.

Digestible protein content of some forages:

1 percent
- Rye straw
- Wheat straw
- Oat straw

3 percent
- Corn fodder
- Corn stover
- Canada bluegrass hay
- Clover straw
- Cowpea straw
- Soybean straw

3 percent (cont.)
Meadow fescue hay
Rye hay
Timothy hay
5 percent
Buckwheat straw
Clover and timothy hay
Barley hay
Kafir fodder
Kentucky bluegrass hay
Millet hay
Mixed grass hay
Oat hay
Orchard grass hay
Prairie hay
Redtop hay
Sweet corn fodder
Wheat hay
7 percent
Alsike clover hay
Emmer hay
Native western bluegrass hay
Peanut vine (without nuts)
Red clover hay
Vetch and oats hay
9 percent
Alfalfa hay (first cutting)
Crimson clover hay
Lespedeza hay
Peas and oats hay
11 percent
Alfalfa hay (second cutting)
Alfalfa meal
Red clover hay (before bloom)
Sweet clover hay
Soybean hay
Vetch hay (common vetch)
13 percent
Cowpea hay
Canadian field pea hay
Velvetbean hay
15 percent
Alfalfa hay (before bloom)
Alfalfa leaves
Hairy vetch hay

Digestibility of hay is not increased by grinding and chopping. Grinding hay too finely may decrease the digestibility of the crude fiber. Either grinding or chopping decreases the refusal or wastage of coarse hays, but is not profitable unless hay prices are high.

Producing dairy cows should not be filled up with the indigestible coarse part of the hay crop. Coarse feeds should be fed to wintering or growing cattle with proper supplements.

Bloat

Bloat can cause serious losses for the dairyman. It occurs frequently on pastures that contain a high percentage of legumes, such as ladino clover or immature alfalfa.

Where the pasture contains about 50 percent of grass, bloat is a less serious problem.

No one theory about the cause of bloat has been established to the satisfaction of scientists interested in the problem. Until the exact cause of bloat is established, no definite preventive measures can be recommended.

Cattle bloat less frequently if they are fed some dry hay before being turned out to pasture. Some dairymen make hay or straw available to the grazing herd.

The dried hay or straw should be coarse, yet sufficiently palatable that it will be readily eaten.

Feeding Concentrates

Profitable Grain Feeding

Cows fed an all-forage ration produce about 30 percent less milk than cows fed grain in average amounts.

To obtain even this production, the forage must be of good-to-excellent quality. Unless the price of milk is low in relation to the price of grain, it usually is profitable to feed some grain.

Whether feeding more than the average quantity of grain will be profitable depends on the quality of the forage available, the cow's ability to produce milk, and the prices of milk, grain, and forage.

By using table 1, you can calculate whether feeding additional grain is profitable under a particular set of conditions.

For example, if the amount of feed you are giving a cow comes to level 5 in the table and you increase the feed to level 6, and the cow produces 322 pounds more milk, the cost of this milk in feed would be 420 pounds more grain and 319 pounds less hay. Feeding the extra grain would be profitable under conditions such as these:

If a price of $4 per hundred is assigned to the milk, grain costs $60 per ton, and hay costs $30 per ton, the extra milk produced would be worth $12.88. The cost of the grain would be $12.60. Subtracting the cost of the hay, the cost to produce the extra 322 pounds of milk—worth $12.88—would be $9.26. Thus, under these conditions it would be profitable to feed at amount level 6 or perhaps even a higher level.

Grain mixtures for dairy cattle do not need to contain many different ingredients to have a high nutritive value. As long as the ingredients are palatable, simple mixtures are just as effective and nutritious; they are easier to mix on the farm.

Mixtures of two or three feed ingredients such as corn or barley and a protein concentrate are adequate for most conditions. Adding a fluffy feed to increase the bulk in the mixture is not necessary unless it increases palatability.

Bulk is of no direct value because the grain mixture is well mixed with the forage part of the ration in the cow's paunch.

Grind homegrown grains before mixing them into a concentrate mixture. If the grain is not ground, some of it will pass through the digestive tract whole, with none of the nutrients removed. This is especially true of corn, sorghum, kafir, milo, and feterita.

The grains should be cracked, not ground to a powder. Fine grinding reduces palatability.

Barley and oats usually are crushed or crimped instead of ground. This makes a coarse fluffy feed that some dairymen like for their cattle.

Protein concentrates usually are the most expensive feeds in the grain mixture.

In areas where protein concentrates are more expensive than carbohydrate concentrates, the level of protein in the grain ration need not be any higher than necessary to meet the requirements of a producing cow. If protein intake is too low milk production decreases.

Table 1.—How feeding levels affect milk production

Level of feeding from lowest to highest	Milk produced per pound of grain fed during lactation	Grain fed annually	Hay fed annually	Estimated quantities of milk these feeds would produce
	Pounds	Pounds	Pounds	Pounds
1	.....	0	11,338	6,488
2	16.7	420	11,048	7,020
3	8.9	840	10,751	7,517
4	6.3	1,260	10,447	7,947
5	5.0	1,680	10,136	8,317
6	4.1	2,100	9,817	8,639
7	3.5	2,520	9,492	8,915
8	3.1	2,940	9,159	9,156
9	2.8	3,360	8,818	9,366
10	2.5	3,780	8,471	9,550
11	2.3	4,200	8,116	9,708
12	2.1	4,620	7,754	9,847
13	2.0	5,040	7,385	9,971

The amount of protein concentrate needed in a grain mixture depends on the protein content of the forages being fed. Usually, high-quality forages have a high protein content.

A grain mixture containing 10 to 12 percent of crude protein with good-quality legume forage, for example, alfalfa hay or silage, is adequate. Little or no protein concentrate is needed with this mixture.

In areas where high-quality legume forages are fed, grain rations containing 18 to 25 percent of protein are being used. These high-protein grain mixtures are not necessary and may not be the most economical to use.

If roughage is made up of mixed forages, or poor-quality legume forages with corn silage, the protein content of the grain mixture should be 12 to 14 percent. Where forage consists largely of grass forages, either as hay or silage with corn silage, the grain mixture should contain 16 to 18 percent of protein.

Suggested concentrate mixtures with forages of different protein content for producing cows are shown in table 2.

Using table 3 you can substitute similar ingredients in dairy rations. The productive energy values in table 3 are the best to use when choosing a substitute ingredient for a ration.

Buy the protein concentrate that offers the most protein per dollar. The cost of a pound of protein at different prices per ton and at different concentrations is shown in table 4.

If it is necessary to purchase high-energy feeds such as corn or barley, you should purchase the feed that furnishes the cheapest source of en-

ergy. The amount of energy as shown on feed sacks usually is given in therms. The cost of a therm of energy for any feed can be calculated by dividing the price of 100 pounds of the feed by the therm value of the feed found in table 3.

Urea

Feeding urea can provide dairy cattle with a protein substitute. They are able to use urea because paunch bacteria convert the urea into amino acids and protein. Protein is stored in the bacteria and becomes available to the animal as the bacteria are digested.

For bacteria to produce protein from urea, it is necessary to have a source of readily available carbohydrate (starch or sugar) present in the paunch. For instance, urea is not used efficiently when fed with a ration such as timothy hay or straw that is low in carbohydrates and protein. However, if starch is added, urea will be efficiently used.

High-carbohydrate feeds, such as cereal grains or molasses, generally

Table 2.—Concentrate mixtures for different forages[1]

When you feed—	You need in the concentrate mixture—	To make this mixture, use—			
		Corn	Oats	Wheat bran	Soybean meal
	Percent of protein	Pounds	Pounds	Pounds	Pounds
Legume hay or legume silage (alfalfa, clover, soybean).	9 to 10	500	+ 500		
		or			
	10 to 12	700	+ 200		
		or			
		500	+ 300	+ 200	
Legume hay and corn or grass silage or mixed hay and corn silage.	12 to 14	500	+ 250		+ 150
		500	+ 300	+ 100	+ 100
		900			+ 100
Grass hay or grass hay and corn silage.	14 to 16	500	+ 200		+ 200
		500	+ 250	+ 100	+ 150
		800			+ 200
Poor-quality grass hay or poor-quality grass hay and corn silage.	17 to 18	500	+ 250		+ 250
		400	+ 200	+ 200	+ 200
		700			+ 300

[1] One percent of salt should be added. In areas of phosphorus deficiency add 1 percent of bonemeal or other low fluorine phosphorus supplements.

Table 3.—Composition of feeds

Feeds	Total dry matter	Digestible protein	Productive energy	Crude protein	Fiber	Calcium	Phosphorus
CONCENTRATES							
Barley:	Pounds	Pounds	Therms	Pounds	Pounds	Percent	Percent
Pacific Coast States	89.9	6.9	79.6	8.7	5.7	0.06	0.33
Other States	89.4	10.0	78.2	12.7	5.4	.06	.40
Beet pulp:							
Dried	91.2	4.1	64.4	8.8	19.6	.69	.08
Molasses, dried	92.2	5.9	69.4	8.9	15.2	.57	.07
Wet	11.6	.8	8.2	1.5	4.0	.09	.01
Brewers' grains, dried:							
25-percent protein	93.0	22.0	61.4	27.5	14.2	.29	.48
Below 25-percent protein	92.8	16.8	53.9	23.3	15.6	.....	.....
Citrus pulp, dried	90.0	2.7	73.9	6.2	11.6	2.04	.15
Corn:							
Dent, yellow, grade No. 2	85.0	7.0	83.3	9.1	2.1	.02	.26
Flint	88.5	7.5	86.8	9.8	1.9	.....	.....
Corn and cob meal (corn ears ground)	86.1	5.4	72.9	7.4	8.0	.04	.22
Corn gluten feed, 25-percent protein	91.0	21.6	74.5	25.1	7.4	.....	.....
Corn gluten meal, 41-percent protein	91.3	36.2	78.9	42.6	4.3	.....	.....
Cottonseed, whole, pressed, 28-percent protein	92.4	20.2	49.3	28.0	21.4	.17	.64
Cottonseed meal:							
36-percent protein	92.6	28.2	57.6	36.1	14.4	.26	.83
39-percent protein	92.6	31.3	63.2	39.6	10.9	.....	.....
41-percent protein	92.9	33.3	68.1	41.6	10.7	.....	.....
43-percent protein	92.8	35.9	69.5	43.3	11.0	.23	1.07
45-percent protein	94.3	37.4	72.5	45.6	10.3	.23	1.12
Distillers' dried corn grains	94.4	19.1	85.4	26.1	12.8	.11	.48
With solubles	92.9	19.4	83.3	26.6	9.2	.16	.74
Hominy feed, white:							
5-percent fat	89.9	7.5	87.0	10.6	4.7	.05	.57
Below 5-percent fat	89.4	7.2	84.0	10.1	3.9	.....	.....
Linseed oil meal, old process, 37-percent protein	91.7	32.6	77.7	37.5	8.2	.39	.86
Molasses:							
Beet	80.5	4.4	57.1	8.4	0	.05	.02
Cane	73.4	0	49.5	3.0	0	.66	.08

Table 3.—Composition of feeds—Continued

Feeds	Total dry matter	Digestible protein	Productive energy	Crude protein	Fiber	Calcium	Phosphorus
CONCENTRATES—Continued							
Oats:	Pounds	Pounds	Therms	Pounds	Pounds	Percent	Percent
Pacific Coast States	91.2	7.0	69.5	9.0	11.0	.11	.39
Other States	90.2	9.4	66.9	12.0	11.0	.13	.35
Peanut oil meal; old process:							
41-percent protein	92.3	36.6	70.7	41.1	15.0	.16	.54
43-percent protein	91.8	38.6	75.5	43.4	12.1	.....	.....
45-percent protein	93.4	40.3	74.2	45.3	12.6	.....	.....
Rye grain	89.5	10.0	76.4	12.6	2.4	.07	.38
Skimmed milk, dried	93.9	29.8	79.5	33.1	.6	1.28	1.04
Soybeans	90.0	33.7	92.4	37.9	5.0	.25	.59
Soybean oil meal:							
41-percent protein	90.9	37.0	77.6	44.0	5.9	.....	.....
43-percent protein	91.4	36.9	78.7	43.9	5.9	.....	.....
44-percent protein	90.3	42.0	78.3	45.7	5.8	.....	.....
Solvent extracted	91.5	40.7	72.3	48.5	2.6	.29	.64
Wheat:							
Bran, all analyses	90.1	13.3	62.2	16.4	10.0	.13	1.29
Flour middlings	90.1	15.4	80.1	17.5	4.3	.09	.71
Northern, spring	90.1	13.3	82.3	15.8	2.5	.06	.45
Soft, Pacific Coast States	89.1	8.3	81.5	9.9	2.7	.....	.....
Standard middlings	89.6	15.0	79.2	17.1	5.2	.09	.93
Whey, dried	93.0	11.5	77.7	12.8	.2	.86	.72
SILAGES							
Alfalfa:							
Wilted	36.2	4.3	17.2	6.3	11.4	.51	.12
Not wilted, no preservative	24.7	2.6	10.0	4.1	8.2	.35	.08
Alfalfa-molasses, not wilted	26.8	2.7	22.3	4.1	8.2	.41	.08
Beet top, sugar	31.6	2.5	9.3	3.8	3.9	.31	.07
Clover, ladino, and timothy	29.9	3.9	19.5	5.4	7.5	.31	.07
Corn:							
Dent, well-matured all analyses	27.6	1.2	26.6	2.3	6.7	.10	.07
Dent, well-matured, well-eared	28.5	1.3	17.7	2.3	6.3	.09	.07
Dent, well-matured, fair in ears	26.3	1.1	14.7	2.1	7.0	.09	.06
Dent, immature, before dough stage	20.3	.9	10.8	1.8	5.8	.11	.07

Table 3.—Composition of feeds—Continued

Feeds	Total dry matter	Digestible protein	Productive energy	Crude protein	Fiber	Calcium	Phosphorus
SILAGES—Continued							
	Pounds	Pounds	Therms	Pounds	Pounds	Percent	Percent
Corn and soybeans, well-matured, 30 percent or more soybeans	28.3	2.0	17.6	3.2	7.3	.20	.08
Grass silage:							
Considerable proportion legumes, wilted	33.3	2.9	14.8	5.2	8.8	.25	.12
Small proportion legumes, wilted slightly, molasses added	29.0	1.7	12.8	3.0	8.9	.....	.07
Small proportion legumes, not wilted	27.6	1.9	11.9	3.2	9.7	.....	.....
Sorghum, sweet	25.4	.8	12.2	1.6	6.9	.08	.05
Soybean, not wilted	24.8	2.9	11.6	4.2	7.3	.35	.09
Sudan grass	25.7	1.5	10.9	2.2	8.8	.11	.04
Timothy, not wilted:							
No preservative	30.9	1.8	14.7	3.3	11.0	.18	.09
No preservative, molasses added	30.0	1.6	13.2	3.1	10.2	.16	.08
DRY FORAGES							
Alfalfa hay:							
All analyses	90.5	10.9	38.6	15.3	28.6	1.47	.24
1/10 to 1/2 bloom	90.5	11.2	39.6	15.4	28.5	1.47	.24
3/4 to full bloom	90.5	10.2	38.0	14.1	30.2	1.22	.22
Past bloom	90.5	9.3	34.2	12.9	31.8	1.10	.20
Dehydrated	91.0	13.2	42.0	19.6	28.0	1.80	.25
Alfalfa leaf meal, good	92.3	16.0	46.6	21.1	16.6	1.69	.25
Barley:							
Hay	90.8	4.0	40.0	7.3	25.4	.26	.23
Straw	90.0	.7	26.6	3.7	37.7	.33	.10
Birdsfoot trefoil hay	91.2	9.8	44.2	14.2	27.0	1.60	.20
Bromegrass hay, all analyses	88.8	5.3	37.9	10.4	28.2	.42	.19
Clover hay:							
Alsike, all analyses	88.9	8.1	43.6	12.1	27.0	1.15	.23
Crimson	89.5	9.8	36.8	14.2	27.4	1.23	.24
Ladino	89.5	14.2	51.7	18.5	21.6	1.53	.29
Red, all analyses	88.3	7.2	42.1	12.0	27.1	1.28	.20

Table 3.—Composition of feeds—Continued

Feeds	Total dry matter	Digestible protein	Productive energy	Crude protein	Fiber	Calcium	Phosphorus
DRY FORAGES—Continued							
	Pounds	Pounds	Therms	Pounds	Pounds	Percent	Percent
Clover and mixed grass hay, high in clover	89.6	5.5	40.9	9.6	28.9	.88	.21
Clover and timothy hay, 30 to 50 percent clover	88.1	4.7	41.0	8.6	30.3	.69	.16
Corn cobs, ground	90.4	0	31.3	2.3	32.1	.11	.04
Cowpea hay, all analyses	90.4	12.3	39.6	18.6	23.3	1.37	.30
Kafir:							
Fodder, very dry	90.0	4.5	42.9	8.7	25.5	.35	.18
Stover, very dry	90.0	1.9	39.6	5.5	29.5	.54	.09
Lespedeza hay:							
Annual before bloom	89.1	7.2	36.9	14.3	22.07	1.03	.20
Annual in bloom	89.1	6.4	32.8	13.0	26.5	1.00	.19
Annual after bloom	89.1	3.6	22.9	11.5	32.6	.90	.15
Mixed hay, good, less than 30 percent legumes	88.2	4.5	35.2	8.4	31.2	.59	.18
Oat hay	88.1	4.9	34.5	8.2	28.1	.21	.19
Oat straw	89.8	.7	30.2	4.1	36.3	.24	.09
Pea hay, field	89.3	10.6	45.4	14.9	24.3	1.22	.25
Peanut hay, mowed	91.4	6.9	41.6	10.6	23.8	.....	.....
Prairie hay, western, good quality	90.4	2.6	34.0	5.7	30.3	.49	.12
Sorghum fodder, sweet, dry	88.9	3.3	41.6	6.2	25.1	.34	.14
Soybean hay:							
Good, all analyses	88.1	9.8	36.4	14.6	28.1	1.10	.22
In bloom or before	88.0	12.0	42.0	16.7	20.6	1.29	.34
Seed developing	88.0	9.8	35.9	14.6	27.2	1.24	.25
Nearly ripe	88.0	10.8	45.6	15.2	24.0	.96	.31
Soybean straw	88.9	1.1	21.6	3.9	41.2	.....	.05
Sudangrass hay, all analyses	89.4	4.3	35.9	8.8	28.0	.36	.27
Timothy hay:							
All analyses	89.0	3.0	36.8	6.6	30.3	.35	.14
Before bloom	89.0	6.1	47.7	9.7	27.9	.....	.....
Full bloom	89.0	3.2	39.7	6.4	30.4	.....	.20
Late seed	89.0	1.9	26.3	5.3	31.2	.14	.15
Wheat hay	90.4	3.3	32.7	6.1	26.1	.14	.18
Wheat straw	92.6	.3	23.0	3.9	37.0	.15	.07

Morrison, F. B. **Feeds and Feeding**. Ithaca, N. Y.: Morrison Publishing Company, 1956. Adapted with permission.

Table 4.—Cost of protein in cents per pound

Cost per ton of concentrate	Crude protein content	Cost of pound of protein	Cost per ton of concentrate	Crude protein content	Cost of pound of protein
Dollars	Percent	Cents	Dollars	Percent	Cents
40	46 to 50	4	60	48 to 50	6
	38 to 44	5		42 to 46	7
	34 to 36	6		36 to 40	8
	28 to 32	7		32 to 34	9
	24 to 26	8		30	10
	22	9		28	11
	20	10		26	12
	18	11		24	13
	16	13		22	14
45	42 to 50	5		20	15
	36 to 40	6		18	17
	32 to 34	7		16	19
	28 to 30	8	65	44 to 50	7
	24 to 26	9		40 to 42	8
	22	10		36 to 38	9
	20	11		32 to 34	10
	18	13		30	11
	16	14		28	12
50	44 to 50	5		26	13
	40 to 42	6		24	14
	34 to 38	7		22	15
	30 to 32	8		20	16
	28	9		18	18
	24 to 26	10		16	20
	22	11	70	48 to 50	7
	20	13		42 to 46	8
	18	14		38 to 40	9
	16	16		34 to 36	10
55	44 to 50	6		32	11
	38 to 42	7		30	12
	34	8		26 to 28	13
	30 to 32	9		24	15
	28	10		22	16
	26	11		20	18
	24	12		18	19
	22	13		16	22
	20	14	75	46 to 50	8
	18	15		40 to 44	9
	16	17		36 to 38	10

Table 4.—Cost of protein in cents per pound—Continued

Cost per ton of concentrate	Crude protein content	Cost of pound of protein	Cost per ton of concentrate	Crude protein content	Cost of pound of protein
Dollars	Percent	Cents	Dollars	Percent	Cents
75—Continued	34	11	90—Continued	34 to 36	13
	32	12		32	14
	28 to 30	13		30	15
	26	14		28	16
	24	16		26	17
	22	17		24	19
	20	19		22	20
	18	21		20	23
	16	23		18	25
80	48 to 50	8		16	28
	44 to 46	9	95	46 to 50	10
	40 to 42	10		42 to 44	11
	36 to 38	11		40	12
	34	12		36 to 38	13
	30 to 32	13		34	14
	28	14		32	15
	26	15		30	16
	24	17		28	17
	22	18		26	18
	20	20		24	20
	18	22		22	22
	16	25		20	24
85	46 to 50	9		18	26
	42 to 44	10		16	30
	38 to 40	11	100	50	10
	36	12		46 to 48	11
	32 to 34	13		44	12
	30	14		40 to 42	13
	28	15		38	14
	26	16		34 to 36	15
	24	18		32	16
	22	19		30	17
	20	21		28	18
	18	24		26	19
	16	27		24	21
90	48 to 50	9		22	23
	44 to 46	10		20	25
	40 to 42	11		18	28
	38	12		16	31

N-22804

Good forage reduces the amount of concentrates cows need.

are used with urea. Starch from grains is more effective than the sugar from molasses.

Natural urea is an excretory product of animal bodies; it is poisonous. Synthetic urea can be poisonous when too large quantities are consumed. Deaths in cattle have resulted from improper mixing of concentrate and urea.

Urea in its crystalline form resembles salt or granular sugar. One pound of it equals the amount of protein in 6.4 pounds of 41-percent soybean meal or cottonseed meal.

Urea for feeding is made from carbon dioxide and ammonia by a chemical process.

When more than 3 ounces of urea per day is fed, milk production is lowered. If the amount of urea is 3 percent of the grain ration, then a cow should not receive more than 6 to 7 pounds of this grain mixture per day.

Caution

- Thoroughly mix urea with the ration.
- Do not use urea to increase the protein level of concentrate mixtures above 16 percent.
- Do not add urea in quantities greater than 3 percent of the grain ration.
- Do not use urea to supply more than one-third of the protein equivalent of the total ration.

Urea is not palatable to cows and is not as readily consumed as oil meals. Do not mix urea with cheap concentrate feeds, high in fiber, merely to meet the protein equivalent needed by producing cows. Such a grain mixture would be of poor quality, low in energy, and unsatisfactory for milking cows.

Urea is not effective when added to high-protein grain rations for milk production. It should not be added to grain rations already containing 14 to 18 percent of protein. When added to homegrown-grain rations containing 10 percent of protein or less, urea is effective.

Where high-protein forages, such as good-quality alfalfa hay, early-cut grass-legume mixtures, or grass silage, are fed along with homegrown grains, adding protein concentrate or urea to a grain mixture will not increase milk production.

If the cost of 1 pound of urea and 6 pounds of carbohydrate concentrate is less than 7 pounds of protein concentrate, it would be economical to use urea.

If it is economical to use urea in rations of producing dairy cattle, mix it with homegrown cereal grains or a high-energy grain mixture. Each percent of urea added to the grain mixture increases the protein

N–4648

Feeding silage as the forage part of the ration.

Table 5a.—Recommended feeding of concentrates for cows on **excellent pasture**[1]

Milk produced daily	Butterfat in milk						
	3.0 percent	3.5 percent	4.0 percent	4.5 percent	5.0 percent	5.5 percent	6.0 percent
Pounds:	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
20	0	0	0	0	0	0	0
25	0	0	0	0	1	2	3
30	0	0	0	1	3	5	6
35	0	0	2	4	6	7	9
40	0	2	4	6	8	10	12
45	2	4	7	9	11	13	15
50	4	7	9	11	14	16	.....
55	6	9	11	14	.....	.....	.....
60	8	11	.....	.....	.....	.....	.....

[1] These rations will provide for all production over 1.2 pounds of butterfat on excellent pasture. If hay or silage is fed, reduce the grain 0.6 pound for each pound of hay consumed and 0.2 pound for each pound of silage.

Table 5b.—Recommended feeding of concentrates for cows on **good pasture**[1]

Milk produced daily	Butterfat in milk						
	3.0 percent	3.5 percent	4.0 percent	4.5 percent	5.0 percent	5.5 percent	6.0 percent
Pounds:	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
10	0	0	0	0	0	0	0
15	0	0	0	1	2	2	3
20	0	1	2	3	4	5	6
25	2	3	4	6	7	8	9
30	4	5	7	8	10	11	12
35	6	7	9	11	12	14	15
40	6	10	11	13	15	16	18
45	10	12	14	16	17	.....	.....
50	11	14	16	18	.....	.....	.....
55	13	16	18	.....	.....	.....	.....
60	15	18	.....	.....	.....	.....	.....

[1] These rations will provide for all production over 0.6 pound of butterfat on good pasture. If hay or silage is fed, reduce the grain 0.6 pound for each pound of hay consumed and 0.2 pound for each pound of silage.

Table 5c.—Recommended feeding of concentrates for cows on **poor pasture**[1]

Milk produced daily	Butterfat in milk						
	3.0 percent	3.5 percent	4.0 percent	4.5 percent	5.0 percent	5.5 percent	6.0 percent
Pounds:	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
5	2	2	2	2	3	3	3
10	4	4	5	5	5	6	6
15	6	6	7	7	8	8	9
20	8	8	9	10	11	11	12
25	9	10	11	12	13	14	15
30	11	12	14	15	16	17	18
35	13	15	16	17	19	20	21
40	15	17	18	20	21	23	24
45	17	19	20	22	24	25	.....
50	19	21	23	24	26	.....	.....
55	21	23	25	27	.....	.....	.....
60	23	25	27	.....	.....	.....	.....

[1] These rations provide for all production on poor pasture. If hay or silage is fed, reduce the grain 0.6 pound for each pound of hay consumed and 0.2 pound for each pound of silage fed.

content of the mixture by 2.6 percent.

If the cereal mixture used contains 9 percent of protein, adding 2 percent of urea increases the protein value of the mixture to about 14.2 percent.

Summer Grain Feeding

Dairy cattle usually need some supplemental feeding because the quality and quantity of grazing differ during the pasture season. Also, high-producing cows usually cannot consume enough pasture to meet their energy requirements. This supplemental feed usually is grain.

If pasture is relatively short during parts of July and August, provide hay or grass silage for feeding. Some dairymen feed all the hay, grass silage, or corn silage their cows will eat throughout the pasture season. In this way, when pasture becomes poor, the cows eat an increasing quantity of forage in the barn.

This feeding program automatically keeps the herd up to its maximum producing ability and prevents a decline in milk production.

Cows on good pasture graze as much as 150 pounds per day, which furnishes about 30 pounds of dry matter. This amount of pasturage will provide enough energy to produce 30 to 40 pounds of milk per day.

The amount of grain to feed for different pasture conditions and levels of milk production is shown in tables 5a, 5b, and 5c.

Table 6a.—Recommended feeding of concentrates for cows fed **liberal amounts of good forage** [1]

Milk produced daily	Butterfat in milk						
	3.0 percent	3.5 percent	4.0 percent	4.5 percent	5.0 percent	5.5 percent	6.0 percent
Pounds:	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
17				1.9	2.2	3.1	3.5
19			1.6	2.8	3.2	4.2	4.6
21	1.5	2.0	2.4	3.8	4.2	5.3	5.7
23	2.3	2.8	3.3	4.7	5.2	6.3	6.8
25	3.0	3.6	4.2	5.6	6.2	7.4	8.0
27	3.7	4.4	5.0	6.5	7.2	8.4	9.1
29	4.5	5.2	5.9	7.5	8.2	9.5	10.2
31	5.2	6.0	6.8	8.4	9.2	10.5	11.3
33	6.0	6.8	7.6	9.3	10.2	11.6	12.5
35	6.7	7.6	8.5	10.3	11.2	12.7	13.6
37	7.4	8.4	9.3	11.2	12.2	13.7	14.7
39	8.2	9.2	10.2	12.1	13.2	14.8	15.8
41	8.9	10.0	11.1	13.1	14.2	15.8	17.0
43	9.6	10.8	11.9	14.0	15.1	16.9	18.1
45	10.4	11.6	12.8	14.9	16.1	18.0	19.2
47	11.1	12.4	13.7	15.9	17.1	19.0	20.3
49	11.8	13.2	14.5	16.8	18.1	20.1	21.5
51	12.6	14.0	15.4	17.7	19.1	21.1	22.6
53	13.3	14.8	16.3	18.7	20.1	22.2	23.7
55	14.1	15.6	17.1	19.6	21.1	23.3	
57	14.8	16.4	18.0	20.5	22.1		
59	15.5	17.2	18.9	21.4	23.1		
61	16.3	18.0	19.7	22.4			
63	17.0	18.8	20.6	23.3			
65	17.7	19.6	21.4	24.2			
67	18.5	20.4	22.3				
69	19.2	21.2	23.2				
71	19.9	22.0	24.0				
73	20.7	22.8	24.9				
75	21.4	23.6	25.8				

[1] Based on liberal daily feeding of good hay or good hay and silage at 2½ pounds of hay per 100 pounds of animal weight.

Morrison, F. B. **Feeds and Feeding.** Ithaca, N.Y.: Morrison Publishing Company, 1956. Adapted with permission.

Table 6b.—Recommended feeding of concentrates for cows fed **usual amounts of good forage** [1]

Milk produced daily	Butterfat in milk						
	3.0 percent	3.5 percent	4.0 percent	4.5 percent	5.0 percent	5.5 percent	6.0 percent
Pounds:	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
10				1.9	2.2	3.1	3.5
12			1.6	2.8	3.2	4.2	4.6
14	1.5	2.0	2.4	3.8	4.2	5.3	5.7
16	2.3	2.8	3.3	4.7	5.2	6.3	6.8
18	3.0	3.6	4.2	5.6	6.2	7.4	8.0
20	3.7	4.4	5.0	6.5	7.2	8.4	9.1
22	4.5	5.2	5.9	7.5	8.2	9.5	10.2
24	5.2	6.0	6.8	8.4	9.2	10.5	11.3
26	6.0	6.8	7.6	9.3	10.2	11.6	12.5
28	6.7	7.6	8.5	10.3	11.2	12.7	13.6
30	7.4	8.4	9.3	11.2	12.2	13.7	14.7
32	8.2	9.2	10.2	12.1	13.2	14.8	15.8
34	8.9	10.0	11.1	13.1	14.2	15.8	17.0
36	9.6	10.8	11.9	14.0	15.1	16.9	18.1
38	10.4	11.6	12.8	14.9	16.1	18.0	19.2
40	11.1	12.4	13.7	15.9	17.1	19.0	20.3
42	11.8	13.2	14.5	16.8	18.1	20.1	21.5
44	12.6	14.0	15.4	17.7	19.1	21.1	22.6
46	13.3	14.8	16.3	18.7	20.1	22.2	23.7
48	14.1	15.6	17.1	19.6	21.1	23.3	
50	14.8	16.4	18.0	20.5	22.1		
52	15.5	17.2	18.9	21.4	23.1		
54	16.3	18.0	19.7	22.4			
56	17.0	18.8	20.6	23.3			
58	17.7	19.6	21.4	24.2			
60	18.5	20.4	22.3				
62	19.2	21.2	23.2				
64	19.9	22.0	24.0				
66	20.7	22.8	24.9				
68	21.4	23.6	25.8				

[1] Based on usual daily rate of feeding good hay or good hay and silage at 2 pounds of hay per 100 pounds of animal weight.

Morrison, F. B. **Feeds and Feeding.** Ithaca, N.Y.: Morrison Publishing Company, 1956. Adapted with permission.

Table 6c.—Recommended feeding of concentrates for cows fed **poor or scanty forage** [1]

Milk produced daily	Butterfat in milk						
	3.0 percent	3.5 percent	4.0 percent	4.5 percent	5.0 percent	5.5 percent	6.0 percent
Pounds:	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
9	2.3	2.8	3.3	4.7	5.2	6.3	6.8
11	3.0	3.6	4.2	5.6	6.2	7.4	8.0
13	3.7	4.4	5.0	6.5	7.2	8.4	9.1
15	4.5	5.2	5.9	7.5	8.2	9.5	10.2
17	5.2	6.0	6.8	8.4	9.2	10.5	11.3
19	6.0	6.8	7.6	9.3	10.2	11.6	12.5
21	6.7	7.6	8.5	10.3	11.2	12.7	13.6
23	7.4	8.4	9.3	11.2	12.2	13.7	14.7
25	8.2	9.2	10.2	12.1	13.2	14.8	15.8
27	8.9	10.0	11.1	13.1	14.2	15.8	17.0
29	9.6	10.8	11.9	14.0	15.1	16.9	18.1
31	10.4	11.6	12.8	14.9	16.1	18.0	19.2
33	11.1	12.4	13.7	15.9	17.1	19.0	20.3
35	11.8	13.2	14.5	16.8	18.1	20.1	21.5
37	12.6	14.0	15.4	17.7	19.1	21.1	22.6
39	13.3	14.8	16.3	18.7	20.1	22.2	23.7
41	14.1	15.6	17.1	19.6	21.1	23.3	
43	14.8	16.4	18.0	20.5	22.1		
45	15.5	17.2	18.9	21.4	23.1		
47	16.3	18.0	19.7	22.4			
49	17.0	18.8	20.6	23.3			
51	17.7	19.6	21.4	24.2			
53	18.5	20.4	22.3				
55	19.2	21.2	23.2				
57	19.9	22.0	24.0				
59	20.7	22.8	24.9				
61	21.4	23.6	25.8				

[1] Based on scanty feeding of good forage or usual amounts of poor forage at 1½ pounds of hay per 100 pounds of animal weight.

Morrison, F. B. **Feeds and Feeding.** Ithaca, N.Y.: Morrison Publishing Company, 1956. Adapted with permission.

If you follow the practice of feeding all the forage your cows will eat in the barn, the "excellent pasture" schedule can be used. The grain ration fed during the *flush* of the pasture season need not contain more than 10 to 12 percent of protein.

A mixture containing 12 to 14 percent of grain should be adequate during the rest of the pasture season.

Winter Grain Feeding

Rules of thumb, such as feeding 1 pound of grain to 4 pounds of milk, or 1 to 6, result in overfeeding low-producing cows and underfeeding high-producing cows. A better system is to feed amounts above a certain level of production because forage intake produces up to 20 pounds of milk per day. Feeding schedules are shown in tables 6a, 6b, and 6c.

As shown in table 6b, a cow receiving good-quality hay and consuming 2 pounds per 100 pounds of body weight while producing 30 pounds of milk containing 4 percent of butterfat requires about 9.3 pounds of grain per day.

If the forage is of good quality and the cows are permitted to eat as much as they want, use table 6a.

If forage is a medium or average quality, or good-quality forage is fed in slightly limited amounts, use table 6b.

If forage is poor quality or mainly grass, or of good quality and fed in limited amounts, use table 6c. Read the pounds of grain necessary according to the butterfat test.

Consider the appearance of your animals and feed grain accordingly. If a cow is too thin, increase the amount of grain. Cows that are too heavy may be fed less grain.

If cows were fed 4 pounds of grain during the dry period, a cow producing 8,400 pounds of milk containing 4 percent of butterfat per year would receive about 1,800 pounds of grain a year, plus good-quality hay. At this rate she would consume 2½ pounds of hay per 100 pounds of body weight.

Molasses

Molasses is widely used in feeds especially in commercially mixed feeds. Often as much as 10 percent of a grain mixture is molasses. Larger amounts can be used on feeds high in crude fiber.

Because molasses is often used with high-fiber feeds to increase their palatability, you should examine the feed tag and determine the amount of fiber in the mixture. Molasses contains about 70 percent as much productive energy as corn.

It contains about 55 percent of sugar, 26 percent of water, and is low in protein. Six and one-half gallons of molasses are equal in energy value to 1 bushel of corn.

Diluted with water one or two times, molasses often is poured over poor-quality forages to increase their palatability. Cows will take 2 to 4 pounds of molasses per day and, in some instances, as much as 8 pounds has been successfully fed.

It is also used as a conditioner in making grass silage.

If fed average-quality hay, so that she would eat 2 pounds of hay per 100 pounds of body weight, this same cow would need about 2,800 pounds of grain per year.

If fed poor-quality hay so that she would eat only 1½ pounds of hay per 100 pounds of body weight, she would need 3,700 pounds of grain per year.

●

Prepared by

Animal Husbandry Research Division

Agricultural Research Service

This bulletin supersedes Farmers' Bulletin 1626, "Feeding Dairy Cows."

Washington, D.C. **Issued November 1960**

U.S. GOVERNMENT PRINTING OFFICE: 1960

For sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.
Price 15 cents